Solar System Exploration Division, GSFC Code 690

GEODYN, NASA GSFC's planetary geodesy software Erwan Mazarico



GEODYN II is the orbit determination and geodetic parameter estimation software developed and maintained at NASA GSFC. It has been and is being used in a variety of planetary missions (NEAR, Magellan, MGS, Odyssey, Venus Express, MRO, LRO, MESSENGER, GRAIL, Dawn, OSIRIS-Rex; CAESAR). With numerous state-of-the-art force and measurement models, it can be used to achieve navigation and science goals.

'Basics'

- time and frame transformation (incl. relavitity)
- ground station position (Earth orientation, solid tide, ocean loading, etc.)
- central body gravity (spherical harmonics, mascons) and tides
- solar system bodies
- solar, albedo, and planetary radiation
- relativistic effects
- external acceleration (e.g., thermal reradiation)
- full binary asteroid capability

Radiometric data

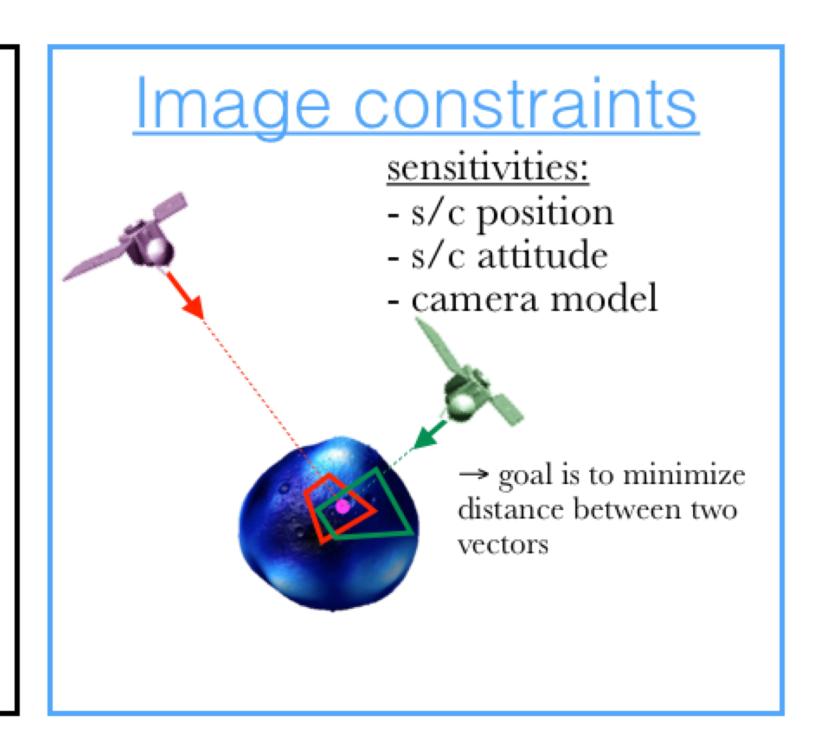
Measurement types:

- Range observations
- Doppler observations
- VLBI observations
- ΔDOR obesrvations (for cruise/flyby)

modeling of corrections for:

- tropospheric and ionopsheric effects
- station position and Earth orientation
- spacecraft antenna phase offset

sensitivities: - s/c position - s/c attitude - camera model - a priori landmark positions → goal is to minimize distance between vector and landmark position



Orientation/Ephemeris

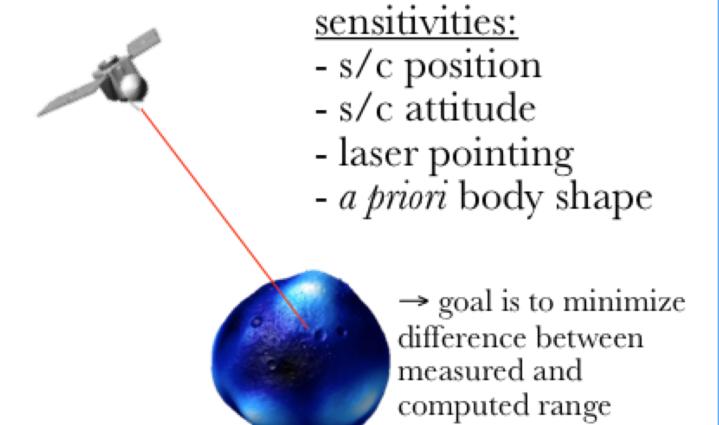
Orientation models:

- analytical: constant, linear and periodic for RA, DEC and W
- dynamical: direct integration of equations of motion from initial state and moments of inertia

Ephemeris models:

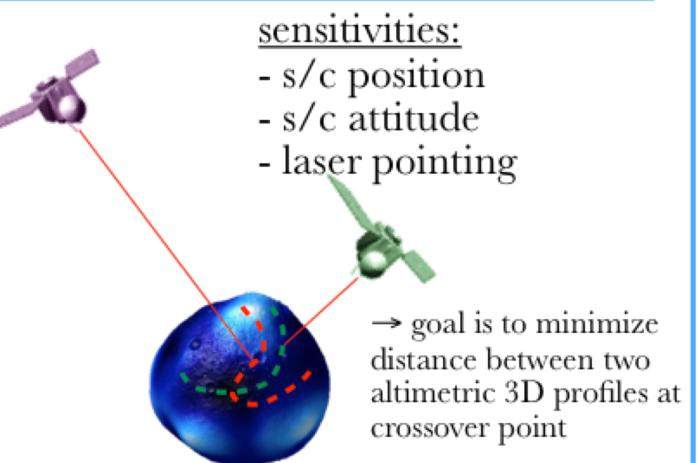
- use of a priori trajectory (e.g.JPL/DE) with estimation of Set III corrections
- direct integration of central body concurrently with spacecraft trajectory (and data analysis)

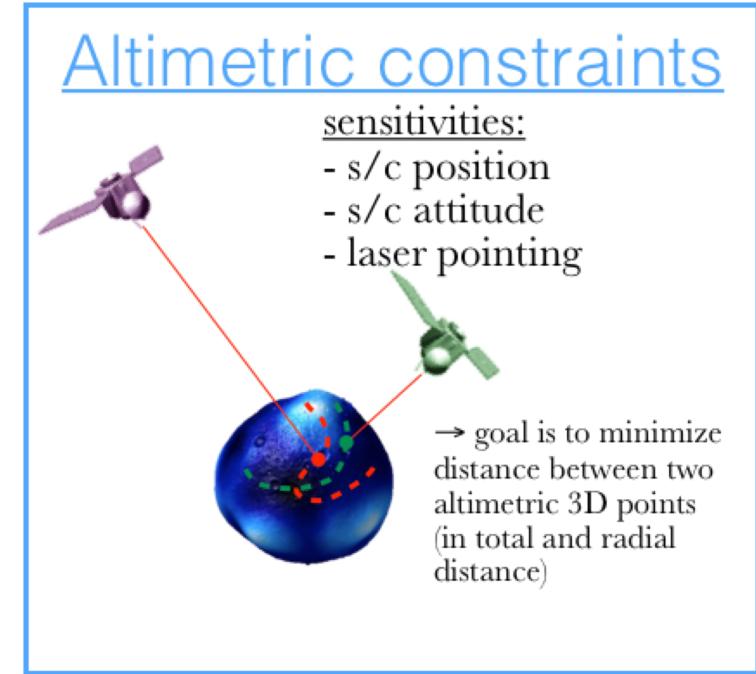
Direct Altimetry



The computed range is the round trip distance from the satellite at transmit time to the location where the ray intersects the DEM back to the satellite at receive time.

Altimetric crossovers





GEODYN can simultaneously use all the measurement types outlined above to yield a comprehensive estimate of geophysical parameters of interest (and their correlation): gravity coefficients; orientation and moments of inertia; ephemeris; tidal Love numbers (gravity and shape); center-of-figure to center-of-mass offset; as well as corrections to spacecraft orbit, camera/laser boresight pointing, landmark positions. With full simulation capabilities, GEODYN can also help develop and demonstrate mission and instrument concepts.

The maintenance and development of GEODYN is supported by the Planetary Geodesy ISFM, to ensure the software remains available for data processing and analysis, and to assure it remains state-of-the-art by implementing new geodetic measurements and models.